

ABSTRACT OF THE DISCLOSURE

A method for chemically bonding semiconductor wafers and other materials to one another without exposing wafers to wet environments, and a bonding chamber for in situ plasma bonding are disclosed. The in situ plasma bonding chamber allows plasma activation and bonding to occur without disruption of the vacuum level. This precludes rinsing of the surfaces after placement in the chamber, but allows for variations in ultimate pressure, plasma gas species, and backfill gases. The resulting bonded materials are free from macroscopic and microscopic voids. The initial bond is much stronger than conventional bonding techniques, thereby allowing for rougher materials to be bonded to one another. This bonded materials can be used for bond and etchback silicon on insulator, high voltage and current devices, radiation resistant devices, micromachined sensors and actuators, and hybrid semiconductor applications. This technique is not limited to semiconductors. Any material with sufficiently smooth surfaces that can withstand the vacuum and plasma environments may be bonded in this fashion.